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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM: **GENEEC and SCI-GROW2 EEC's for the Current Use of Butylate on Corn for the Purpose of Tolerance Reassessment.**

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General Conclusions

Butylate is mobile to slightly mobile in soil. However, based on the vapor pressure and Henry's Law Constant, it is expected to dissipate primarily by volatilization. Significant residues of butylate are not expected to reach surface or ground water.

This Tier I assessment contains an environmental fate assessment, a brief summary of monitoring data, and estimated environmental concentrations (EEC's) for both surface and ground water for parent butylate for the current use on corn. EFED is responding to HED requests for the purpose of tolerance reassessment.

This memorandum assesses only parent butylate; it does not assess any degradates of butylate, based on personal communication with Virginia Dobozy of HED. There are USGS monitoring data for both surface and ground water for parent butylate in areas where butylate is applied to corn. In the NAWQA database, there are over 5,000 samples for surface water and 3,000 samples for ground water. Both the surface water and ground water monitoring data show levels lower than predicted by the Tier I models, GENEEC and SCI-GROW2. EFED notes that neither GENEEC nor SCI-GROW2 take into account volatility from soil or water. Based on laboratory data, butylate dissipates primarily by volatility from soil. Therefore, modeling estimates would likely be lower if volatility were taken into account. The monitoring information for surface water and ground water is more consistent with the environmental fate data and chemical properties than the modeling estimates. EFED recommends using a conservative approach for this Tier I assessment. The modeling estimates should be used for exposure assessment for both surface and ground water.

Table 1 presents the Tier 1 EEC's for **surface water** using GENEEC. For surface water, the maximum concentration of 33.1 ug/L should be used for acute risk calculations. The 56-day EEC of 29.8 ug/L should be used for chronic risk and cancer risk calculations. Table 2 presents the Tier 1 acute and chronic **ground water** concentrations using the SCI-GROW2 model. For ground water, the SCI-GROW2 concentration of 0.41 ug/L for butylate should be used for acute, chronic, and cancer risk assessment.

Tables 3 and 4 below list the GENEEC and SCI-GROW2 inputs for parent butylate, respectively. The Comments column of each table lists the justification for each input.

Table 1.Tier I upper tenth percentile EEC's for Parent Butylate.

Compound	Maximum ($\mu g \cdot L^{-1}$)	4 Day ($\mu g \cdot L^{-1}$)	21 Day ($\mu g \cdot L^{-1}$)	56 Day ($\mu g \cdot L^{-1}$)
Parent Butylate (applied using center-pivot irrigation)	33.2	32.9	31.7	29.8
Parent Butylate (soil-incorporated)	31.5	31.2	30.1	28.2

Table 2. Acute and Chronic Concentrations of Parent Butylate in Ground Water Using SCI-GROW2.*

Compound	Acute ($\mu g \cdot L^{-1}$)	Chronic ($\mu g \cdot L^{1}$)	Cancer ($\mu g \cdot L^{-1}$)
Parent Butylate	0.41	0.41	0.41

* SCI-GROW2 does not take into account the method of application.

<u>Surface Water Inputs (Table 3)</u>

Table 3. Surface Water Exposure Inputs for GENEEC for Parent Butylate.

MODEL INPUT VARIABLE	INPUT VALUE	COMMENTS
Application Rate (lbs ai/A)	6.1 (56.8 % emulsifiable concentrate)	Maximum application rate in labels. Reg. Numbers 51036-248, 34704-702, 10182-409.
Maximum No. of Applications	1	Butylate can be applied at different times in a crop year. However, 1 application at crop preemergence provides a maximum-exposure scenario.
K_{oc}	247	Silt loam K_d of 5.47/2.2 % OC. MRID 41812202.

Aerobic Soil Metabolic Half-life (days)	23.9 days	Only one half-life available. MRID 41812201.
Is the pesticide wetted-in?	Yes	All labels. The labels allow for center pivot irrigation to penetrate soil to a depth of 5-7 inches. The EFED reviewer ran GENEEC using both wetted-in and soil-incorporated treatment methods.
Depth of Incorporation (in.)	6	All labels. The labels also allow for center pivot irrigation to penetrate soil to a depth of 5-7 inches. For both soil-incorporated and wetted-in, EFED used a 6 inch soil depth.
Spray Drift	1	Aerial or airblast = 5%; Ground = 1%; Granular = 0%. EFED used 1 % for center pivot irrigation and ground spray.
Solubility (mg/L)	4,400 mg/ml (ppm)	Butylate RED Document
Aerobic Aquatic Metabolic Half-life (days)	0	No data are available.
Hydrolysis Half-life (days)	0 (stable)	MRID 40389111
Photolysis Half-life (days)	0 (stable)	MRID 40389111

Limitations of This Analysis

There are certain limitations imposed when Tier I EEC's are used for drinking water exposure estimates. A single 10 hectare field with a 1 hectare pond does not reflect the dynamics in a watershed large enough to support a drinking water facility. A basin of this size would likely not be planted completely to a single crop nor be completely treated with a pesticide. Additionally, treatment with the pesticide would likely occur over several days or weeks, rather than all on a single day.   This would reduce the magnitude of the concentration peaks, but also make them broader, reducing the acute exposure but perhaps increasing the chronic exposure. The fact that the simulated pond has no outlet is also a limitation as water bodies in this size range would have at least some flow through (rivers) or turnover (reservoirs). In spite of these limitations, a Tier I EEC can provide a reasonable upper bound on the concentration found in drinking water if not an accurate assessment of the true concentration. The EEC'S have been calculated so that in any given year, there is a 10% probability that the maximum average concentration of that duration in that year will equal or exceed the EEC at the site. Risk assessment using Tier I values can capably be used as refined screens to demonstrate that the risk is below the level of concern.

<u>Ground Water Inputs (Table 4)</u>

Table 4. Ground Water Exposure Inputs for SCI-GROW2 for Parent Butylate		
MODEL INPUT VARIABLE	INPUT VALUE	COMMENTS
Application Rate (lbs. ai/A)	6.1	Maximum application rate in labels. Reg. Numbers 51036-248, 34704-702, 10182-409.

Maximum No. of Applications	1	Butylate can be applied at different times in a crop year. However, 1 application at crop preemergence provides a maximum-exposure scenario.
K_{oc}	421	Median K_{oc} for butylate per model guidance. MRID 41812202.
Aerobic Soil Metabolic Half-life (days)	23.9	Only one half-life available. MRID 41812201.

Limitations of the Analysis

The SCI-GROW2 model (Screening Concentrations in Ground Water) is a model for estimating maximum concentrations of pesticides in ground water. SCI-GROW2 provides a screening concentration, an estimate of likely ground water concentrations if the pesticide is used at the maximum allowed label rate in areas with ground water exceptionally vulnerable to contamination. In most cases, a majority of the use area will have ground water that is less vulnerable to contamination than the areas used to derive the SCI-GROW2 estimate.

The SCI-GROW2 model is based on scaled ground water concentration from ground water monitoring studies, environmental fate properties (aerobic soil half-lives and organic carbon partitioning coefficients-K_{oc}'s) and application rates. The model is based on permeable soils that are vulnerable to leaching and on shallow ground water (10-30 feet).

Surface Water Monitoring Data from NAWQA

There were 295 detections in 5,193 samples for surface water. Most of these detections (60.6 %) were in the White River in Indiana, whose basin contains significant corn production. The detections ranged from 0.002 ug/L to 1.4 ug/L, with 3 detections of >1 ug/L, 17 detections of 0.1-1 ug/L, and 275 detections of 0.002-0.1 ug/L. Detection limits ranged from 0.019-0.002 ug/L.

Ground Water Monitoring Data from NAWQA

There were only 7 detections in 3,205 samples for ground water, ranging from 0.002-0.045 ug/L. There were also 5 estimated detections ranging from 0.002-0.004 ug/L. Detection limits ranged from 0.014-0.002 ug/L. However, it was unclear if all of the ground water samples were actually taken in corn growing areas.

Comparison of Modeling versus Monitoring.

Both the surface water and ground water monitoring data show levels of butylate that are lower than predicted levels in the environment using GENEEC and SCI-GROW2. EFED notes that neither GENEEC nor the SCI-GROW2 models accounts for volatility from soil or water. Based on laboratory data, butylate dissipates primarily by volatility from soil and water. Therefore, modeling estimates would likely be lower if volatility were accounted for in the models. While the monitoring information for surface water and ground water are more consistent with the environmental fate data and chemical properties than the modeling estimates, EFED recommends using the more conservative modeling data for this Tier I assessment.

Environmental Fate Assessment

There are insufficient data for a comprehensive environmental fate assessment for butylate at this time. A preliminary assessment from acceptable laboratory data infers that volatilization is an important (and perhaps the major) route of butylate dissipation. Supplemental field dissipation studies indicate that the half-life of butylate in soil is 12-13 days; the same studies provide indirect evidence that substantial volatilization occurs under actual use conditions. It is not possible to quantify the extent of volatilization in the absence of field volatility data. Mineralization to CO_2 occurs also, but this appears to be secondary to volatilization as a dissipation pathway. Parent butylate is mobile to slightly mobile in soil; it appears to be more mobile in soils low in organic matter.

Unless stated otherwise, the following environmental fate assessment is based on acceptable studies:

Butylate did not hydrolyze significantly in pH 5, 7, and 9 sterile aqueous buffered solutions containing 1% acetonitrile incubated in the dark at 25 ± 1°C or 40°C ($t_{½}$ >>33 days). It did not photolyze in sterile aqueous pH 7 buffered solutions irradiated continuously for 30 days with a xenon arc lamp. Butylate degraded slowly in a photodegradation on soil study with an average of 82% of the applied remaining undegraded after 30 days of irradiation. However, soil photolysis is not expected to occur under field conditions because butylate is volatile and soil incorporated. In an aerobic soil metabolism study, butylate degraded with a reported half-life of 23.9 days in sandy loam soil that was incubated for 245 days in darkness at 24°C. The decline in butylate soil residues was due primarily to volatilization (47% of the applied radioactivity was present as volatilized parent at day 28) with aerobic soil metabolism of secondary importance. At the end of the study, $^{14}CO_2$ and organic [^{14}C]volatiles (of which >93% was butylate) totaled 21.16 and 57.94% of the applied radioactivity, respectively. Butylate degraded with a half-life of 63.6 days in anaerobic (flooding plus nitrogen atmosphere) sandy loam soil that was incubated in the dark at 24°C for up to 60 days following 20 days of aerobic incubation. The decline in butylate soil residues was due primarily to volatilization (about 60% of the decline in soil residues during the anaerobic incubation period was due to volatilization of parent) with anaerobic soil metabolism of secondary importance. In batch equilibrium experiments, butylate was determined to be mobile to moderately mobile in Keeton sandy loam, Columbia loamy sand, Sorrento loam, and Atterberry silt loam soils. The respective Freundlich K_{ads} values reported for these soils were 1.48, 4.84, 7.28, and 5.47 ml/g. Aged leaching data are needed to assess the mobility of butylate degradation products.

In two supplemental terrestrial field dissipation studies conducted in California, butylate dissipated with half-lives of 12-13 days from the upper 6-7 inches of sandy loam soil that was treated with a soil-incorporated application of butylate emulsifiable concentrate at 6 lb a.i./A. Neither butylate nor its degradation products were detected deeper than 9 inches. In a supplemental study, butylate residues accumulated in bluegill sunfish with maximum mean bioconcentration factors of 180X, 630X, and 410X for edible, non-edible, and whole fish tissues, respectively. After 14 days of depuration, 98-99% of the residues were eliminated from fish tissues.

The nonvolatile degradates identified in laboratory studies were butylate sulfoxide, diisobutylformamide, oxazolidinone, hydroxyisobutyl butylate, butylate S-acid, butylate N-acid, and diisobutylamine. In the aerobic soil metabolism study, butylate sulfoxide comprised a maximum of 0.224 ppm (4.4% of the applied radioactivity) after 59 days of incubation. This was the highest concentration of any degradate detected. Volatile degradates were comprised almost entirely of parent butylate.

The moderate value of the calculated Henry's Constant (8.26×10^{-6} atm-m^3/mol), combined with the compound's volatility, indicate that once in the atmosphere, butylate may be transported in fogs, mists, and rainwater. Also, because butylate is often applied to bare ground as a pre-emergence herbicide or shortly after planting, and because it is mobile to moderately mobile in soil, runoff to surface water may follow a rainfall event.